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Cushcraft R5 Multiband Vertical Antenna

Cushcraft D3W World Ranger 12, 17 and 30-Meter Rotatable Dipole

Conducted By James W. Healy, NJ2L
Assistant Technical Editor

Cushcraft R5 Multiband Vertical Antenna

Reviewed by David Sumner, K1ZZ

Let me begin this review with a confession: I like big antennas. The larger and higher they are, the better. A well-engineered stack of HF monobanders is to me a thing of beauty the equal of Eero Saarinen's best work.

So, how did the boss come to review a little bitty thing like Cushcraft's R5 vertical antenna? When the review assignments came around, did he draw the short straw? No. Actually, I asked for the job. With an ulterior motive, of course. Maybe two.

My first motive was selfish: My wife, Linda, KA1ZD, and I were planning a week's vacation which, for the first time in several years, would include some portable hamming. The last time, we had headed to a place with lots of trees and there was no problem stringing a dipole to get on the air. Our new destination, which neither of us had ever seen, reportedly had no trees. So, other antenna possibilities had to be explored. I'd had some experience with multiband quarter-wavelength verticals, and, although they're fine for some applications, portable operation from an unfamiliar location isn't one of them; good performance depends too much on what sort of ground, real or artificial, you can provide the antenna to work against. Laying a lot of radials, even temporary ones, doesn't square with my idea of a vacation.

The R5, less than 17 feet tall, is electrically a half-wavelength antenna on each of the five bands it is designed for: 20, 17, 15, 12 and 10 meters. Therefore, a ground system aside from that needed for safety is not required. Also, the height of such an antenna above ground shouldn't make a lot of difference as long as it's in the clear and out of reach of curious passersby, human or otherwise. If it worked passably well, the R5 would solve the antenna problem on five bands—and I was looking for a chance to get a feel for how well it would do by comparing it to the regular home-station antennas at K1ZZ/KA1ZD.

My second reason for being interested in the R5 was a little different. The middle school in the town where I live has a terrific teacher who, though not yet a ham himself, has gotten quite a few kids interested in ham radio through shortwave listening. He's organized a Novice class and has found some money for equipment, but the school is about to undergo major renovation and it will be a while before a permanent, rotary antenna can be installed. So, I thought, I'd test the antenna at home, then bring it over to the school and let the kids use it.

The antenna arrived by UPS in a 50 × 7 × 3½-inch box weighing less than 11 pounds. The R5 uses loading elements near the top of the antenna to allow a short overall length. Four 48-inch radials mount at the antenna base, adjacent to the matching network and mast-mounting location. The R5 can be mounted to masts from 1½ to 1¾ inches in diameter. Putting the R5 together took all of 45 minutes, thanks in large part to Cushcraft's clear and detailed instructions. One thing I especially liked about the instructions, in addition to their beautifully presented parts lists, their accurate, informative drawings and their precise use of English, was the special care Cushcraft has taken to emphasize safety. *Read the instructions.* It could save somebody's life.

The most convenient way for me to install the R5 at home, and one that would put it at least 200 feet from my other HF antennas to eliminate interaction, was to mount it on top of a ten-foot section of TV mast strapped to my daughter Deryn's swing set. I wouldn't recommend this as a permanent solution (see the preceding paragraph about safety), and besides, being a child of the '80s, she charged me rent. But it was a fine test setup, since the tests took place in March—and that's not a month when swing sets get a lot of use in Connecticut!

Once the coax was hooked up, I was pleasantly surprised at how well the R5 worked. The SWR was no higher than 1.8:1 on any part of any band except in the CW portion of 20 meters, and that was easily adjusted by lengthening the topmost piece of tubing according to the instructions. In most parts of the bands, the SWR was below 1.5:1. The first call, running 25 watts on ten-meter phone, brought back an Italian station. Other Europeans and South Americans quickly found their way into the log. With 100 watts on 15-meter SSB, it was no problem to work lots of stations in Japan, not that easy a path from New England.

The initial Cushcraft design for a multiband half-wave vertical, the R3 (for 20, 15 and 10 meters), used a remotely tuned variable capacitor at the base of the antenna to adjust it for use at different frequencies. In the R5, that matching system has been replaced with one that requires no tuning. The system has three elements. Working from the feed line toward the antenna, the first is a 1:1 balun to isolate the feed line. The second is a transformer to match the resistive part of the antenna's impedance to 50 Ω. The third is a network designed to cancel the inherent reactance of the antenna. The matching system works: The antenna covers all five bands with no adjustment or outboard matching network, and with no apparent loss of efficiency.

I tested the R5 with up to 1100 watts output (the most I'm equipped to generate) to make sure it could handle high power, but I mostly operated "barefoot." Wet weather had negligible effect on the R5's SWR. The antenna worked fine on all five bands, but I had the most fun with it on 18 MHz. Gain antennas are still a bit rare on this newest of our HF bands, so a half-wave vertical can hold its own in most company.

The regular antennas at K1ZZ/KA1ZD are monoband Yagis about 90 feet high and a tribander (20, 15 and 10 meters) at 50 feet. Did the R5 outperform any of these? Of course not. The laws of physics haven't been repealed. But occasionally the vertical surprised me by working just as well, and it provided lots of solid QSOs. There was no problem in conducting intercontinental CW ragchews while operating barefoot.

Transplanted to the top of a two-foot mast on the roof of the school, the R5 duplicated its previous performance: It loaded up nicely on all bands, and provided an inaugural 10-meter QSO with Liberia for the school's IC-725. While the kids awaited their Novice licenses, the antenna was so popular for shortwave listening, and is so unobtrusive, that the school has decided to keep it—even if they get a rotary antenna later.

Some users of the R5 have found that installing it too close to a ground system of resonant radials (such as might be installed under a quarter-wavelength vertical) detunes the antenna, making readjustment necessary. Since such a radial system is not needed with the R5, the easier solution is to move the antenna or remove the radials. The only other caveat about installation is that the base of the antenna should be at least four feet off the ground—but you'd want it higher than that anyway, for safety's sake. (The short, stainless steel radials at the base of the antenna are hot with RF when you're transmitting.)

How did the R5 work on vacation? It did everything I hoped, and more. We took along two five-foot sections of TV mast, cut down slightly to fit easily in the back of our small station wagon. Onto these we mounted the R5 and strapped the assembly to a fence post, putting the base of the antenna nine feet above ground. The R5 was fed through 100 feet of good-quality coaxial cable. In 27½ hours of operating over 5½ days, we made 2788 CW QSOs with 87 countries, mostly on 14, 18 and 21 MHz, but with a healthy number on 24 and 28 MHz as well. Oh, yes, the call sign didn't hurt: Courtesy of Bob Morrison, VY2ZZ, and the Canadian Radio Relay League, we used CRRL's Prince Edward Island call sign, VY2QST. The VY2 prefix (which is not a special one—it's been

the regular prefix for PEI since late last year) attracted a lot more attention than I had expected! If you heard or worked VY2QST between August 5 and 11, you heard the antenna for yourself; it's the only one we used. Ten minutes after securing operation, the R5 was dismantled and stowed in the back of the car, ready for the trip home. By any standard, that's a pretty high performance-convenience product.

In short, the R5 is a no-hassle solution to five bands' worth of antennas. It's easy to put together and even simpler to use. It can be installed just about anywhere as long as it's out of reach of curious fingers, and should work well at any height above ground provided it's in the clear. It's a natural for portable operation, and for home-station use when a rotary antenna isn't practical, or to add coverage of the 18- and 24-MHz bands (plus an omnidirectional backup antenna for the other three bands) to an existing antenna farm.

Manufacturer's suggested retail price: $340. Manufacturer: Cushcraft Corporation, PO Box 4680, Manchester, NH 03108, tel 603-627-7877.

CUSHCRAFT D3W WORLD RANGER 12, 17 AND 30-METER ROTATABLE DIPOLE

Reviewed by David Newkirk, AK7M

Let me begin *this* review with another confession: I *don't* like big antennas. I freely admit to believing that if I can't enjoy and be amazed by radio without erecting hundreds to thousands of pounds of aluminum and galvanized steel in my backyard, radio is too hardware-intensive for me. QRP hamming—*QRP* meaning, to me, *quietly reduced pretentiousness*—is my thing. I differentiate AK7M QRP from the mainstream variety by calling it QRP[2]—optional, *low-field-strength* Amateur Radio communication for fun.[1] You'll usually find me QRP[2]ing at 10 or 18 MHz[2]—often with home-spun radio gear.

A typical AK7M QRP[2] antenna consists of an end-fed random wire. (Okay, okay: Occasionally I take a walk on the wild side and install a tuned-feeder doublet.) Buying a commercial antenna, no matter how closely it approaches QRP[2]ness, generally doesn't occur to me. But when the Product Review editor proposed that I review Cushcraft's D3W, I bit—hard. *Sure* I'd review a commercial product that covers my favorite bands and might lure more victims into my QRP[2] clutches!

Cushcraft's D3W World Ranger rotatable dipole is simple to build, install and use. It weighs only 11 pounds when assembled and can be installed on masts up to 2-1/8 inches in diameter. It covers our three newest HF bands (10, 18 and 24 MHz). Designed for 50-ohm coax feed, the D3W is designed to exhibit an acceptably low SWR (1.5 to 1 or less) across its three bands. (And yes, it's designed to handle somewhat-higher-than QRP[2] power: 2 kW PEP. Keep in mind, however, that the US power-output limit at 30 meters is *200 W* PEP.) The D3W comes in a UPS-shippable box that's about 6 feet × 3 inches × 4 inches (LWD); its design length is 34 feet, ¼ inch long, assembled.

The D3W is a *trap* half-wave dipole. A trap is a tuned circuit that blocks the passage of energy at and around its resonant frequency; breaking an antenna element with appropriately tuned traps can allow that element to resonate on more than one band. The D3W's inner traps "disconnect" enough of the elements' tubing to resonate the antenna at 24 MHz; the outer traps disconnect somewhat less of the element material, resonating the D3W at 18 MHz; and the entire antenna resonates at 10 MHz. All *you* do to change bands with the D3W is change bands with your rig.

Assembling the D3W per Cushcraft's instructions took between 1 and 1½ hours, all told.[3] (My two stepchildren, 5 and 7 years old, helped make construction easy by occasionally diverting my thoughts elsewhere!) I installed the completed antenna atop a 20-foot TV mast bolted to the side of my radio shed. I didn't consider mounting the D3W on a rotator because I knew from studying Figs 11 and 12 in Chapter 3 of *The ARRL Antenna Book* that it would be largely omnidirectional at 10 and 18 MHz when mounted at 20 feet.

Initial SWR tests, made with a Bird 43P wattmeter at 50 watts output through 35 feet or so of RG-8 coax, revealed SWRs higher than specified: 1.8 at 10.1 MHz, 2.4 at 10.15 MHz; 1.8 at 18.068 MHz, 1.7 at 18.168 MHz; and 1.8 at 24.89 MHz, 1.7 at 24.99 MHz. I inferred from this that the D3W was resonant *below* the band at 30 meters, and *above* the band at 17 and 12. Had I goofed? Rus Healy, NJ2L, and I rechecked my installation. My element lengths and trap spacings were spot on with Cushcraft's documentation. What about the antenna height? (Cushcraft says only that "the antenna must be in a working position for a good VSWR test.") Working position? However you "de-hazify" that term, 20 feet should be plenty of feet—even at 10 MHz. Okay, okay, I'd made my coax pigtails a bit longer than directed by Cushcraft; *that* could cause that below-the-band resonance—shortening them helped, but didn't bring the 30-meter SWR into spec.

Cushcraft does not suggest what to do if the D3W's SWR is out of specification, but adjust-and-try modification of some of Cushcraft's suggested element lengths paid off reasonably well. Working from the D3W's assembly instructions, we found that lengthening Drawing 4's 98-inch dimension to 99 inches, and shortening Drawing 4's 73-inch dimension to 71-1/8 inches (an overall antenna-length change of only 1¾ inches), netted these SWRs: 1.35 at 10.1 MHz, 1.5 at 10.15 MHz; 1.9 at 18.068 MHz, 1.8 at 18.168 MHz; and 1.8 across the entire 24-MHz band. Fed through about 100 feet of RG-8, the SWR was 1 at 10.1 MHz, 1.2 at 10.15 MHz; 1.7 at 18.068 MHz, 1.4 at 18.168 MHz; and 1.3 across the 24-MHz band.

Our radio-shed R & D also indicated that the shed was buggy enough to drive *me* buggy, so I relocated my 10-watt-output transceiver to the house. This required that I feed the D3W (via the 35 feet or so of RG-8 already attached to it) with the only long piece of coax I had: A hundred-foot spool of RG-188A Teflon®-dielectric cable. Although RG-188A is high-quality stuff, it's lossy—just under 4 dB per hundred feet at 10 MHz, and somewhat less than 6 dB per hundred feet at 25 MHz. I calculated that the D3W would receive about 5 W at 10 MHz and 3.1 W at 18 MHz when fed via the RG-188A. (Receive insensitivity due to cable loss temporarily put me out of business at 24 MHz; I could hear down to the band noise at 10 and 18.)

Lossy feeder? Ha! A true QRP[2]er cares not. Within the next three days, I worked Venezuela, Mauritius, and New Zealand on 10 MHz; the Ukraine, New Zealand, Mauritius, Poland and Senegal on 18 MHz; and—after borrowing enough Belden 9913 coax from NJ2L to replace the RG-188A—the Canary Islands on 24 MHz.

Clearly, the D3W works fine. It's not a "big" antenna; it's an unpretentious, well-engineered, multiband dipole that goes together easily and affords you solid access to Amateur Radio doings on our three newest HF bands. I recommend it without reservation.

Manufacturer's suggested retail price: $210. Manufacturer: Cushcraft Corporation, PO Box 4680, Manchester, NH 03108, tel 603-627-7877. QST

[1] *Field strength at the other end of the communication circuit*—not just transmitter power, which is only one factor in the equation—is really what's at issue in comparing one transmitter/antenna to another. Never mind that no consumer-priced, off-the-shelf means of accurately measuring MF/HF field strengths in microvolts per meter are currently available to hams.

[2] By the way, I can't stand singling out 10, 18 and 24 MHz as *WARC bands*. After all, it's 1990, and WARC-79 happened almost *11 years ago!* Besides, burdening 12, 17 and 30 with this monicker isn't fair to our other "WARC" bands: We won 15 meters, for instance, at WARC-47. "Our three newest HF bands" is the phrase to use where necessary. (Disregard this diatribe if you're still referring to the Montreal Expos as an "expansion team.")

[3] When you build yours, be sure to position the traps with their drainage holes *down*—and consider applying conductive, anti-oxidant grease between the D3W's tubing sections as you fit them together. Cushcraft doesn't mention these points in the D3W's documentation, which is nonetheless first-rate.

Feedback

☐ Delete the phrase *at the transmitter side* in line 5, paragraph 3, column 1 on page 32 in August 1990 *QST*'s "The Off-Center-Fed Dipole Revisited—A Broadband, Off-Center-Fed Antenna" by John S. Belrose and Peter Bouliane.—*AK7M* QST